



Chapter Four

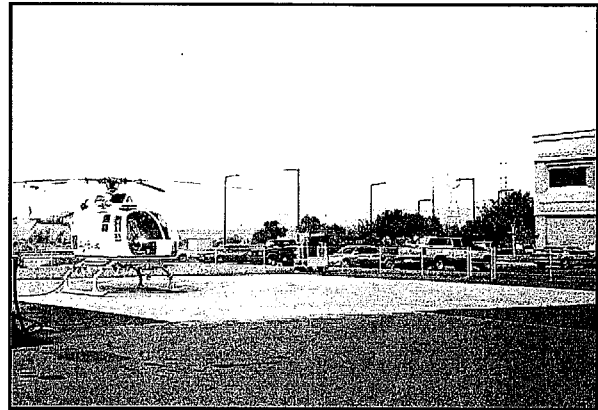
DEVELOPMENT ALTERNATIVES

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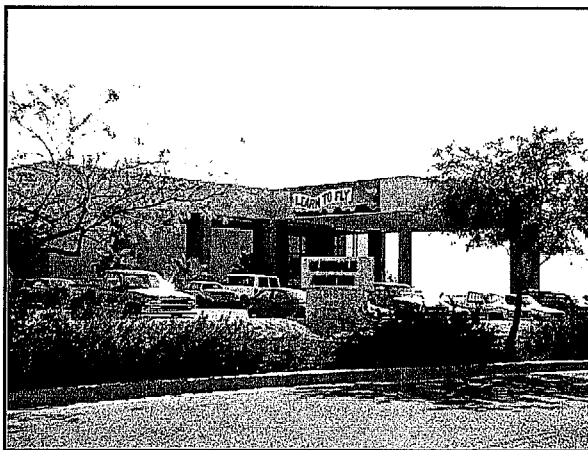


In the previous chapter, airside and landside facility needs that would satisfy projected demand over the planning period were identified. The next step in the master planning process is to evaluate the various ways these facilities can be provided. In this chapter, these facility needs will be applied to a series of airport development alternatives. The possible combinations of alternatives can be endless, so some intuitive judgement must be applied to identify those alternatives which have the greatest potential for implementation. The alternatives analysis is an important step in the planning process since it provides the underlying rationale for the final master plan recommendations.

The development alternatives for the airport can be categorized into two functional areas: the airside (airfield) and landside (aircraft storage facilities,



aircraft parking apron). Within each of these functional areas, specific facilities are required or desired. Although each functional area is treated separately, each area interrelates to each other and affect the development potential of the other. Therefore, these areas must be examined both individually and collectively to ensure a final plan that is functional, efficient, cost effective, and minimizes environmental impacts. Through this process, a basic airport concept is developed into a realistic development plan.



While any evaluation of alternatives can also include a "no action" alternative, this would effectively reduce the quality of services being provided to the general public, and potentially affect the area's ability to accrue additional economic growth. The airport's aviation forecast and the analysis of facility requirements indicates both a current and future

need for the development of a longer runway, additional taxiways, improvement of navigational aids and lighting, and aircraft storage facilities. Without these facilities, regular users of the airport will be constrained from taking maximum advantage of the airport's air transportation capabilities.

Although this study will not consider the relocation of services to another airport, it is always a potential alternative. While there are eleven public-use airports located within a 30 nautical mile radius of the airport, they are not as convenient and will not enhance community development in the City of Glendale. Furthermore, the continuing growth expected by the major employers in the area that use the airport's facilities demonstrates the important role that an airport plays. A role that is not easily replaced by another existing airport in the system without tremendous expense. Therefore, the master planning process must attempt to deal with the facility needs which have been identified in the previous chapter, at the levels forecast throughout the twenty-year planning period.

PREVIOUS MASTER PLAN

The previous airport master plan for Glendale Municipal Airport was completed in 1989. In 1987, the base year for the master plan study, there were 168 based aircraft and annual operations were at a level of 73,000 with over 46,000 of these attributable to local training activity. Based aircraft were forecast to increase to 466 and annual operations were forecast to increase to 256,000. A parallel runway

was recommended to increase airfield capacity to efficiently accommodate forecast demand. The plan also identified the need to upgrade the existing primary runway to accommodate larger corporate aircraft. This included widening the runway from 75 to 100 feet, extending the runway 750 feet, reconfiguring aircraft tie-downs and strengthening airport pavement. Additional recommendations in the 1989 master plan included the construction of 80 T-hangar facilities, the acquisition of 23 acres of land to protect the runway protection zones, and the construction of an on-airport heliport.

A nationwide general aviation industry downturn and the suspension of operations by ATC, a large airline training organization, at the airport reduced demand at the airport; consequently many of the recommended improvements were not completed. Following the national trend, based aircraft totals decreased 41 percent and annual operations decreased 33 percent at the airport between 1990 and 1993. Since falling to 10-year lows during that period, based aircraft totals have increased 31 percent and annual operations have increased 5 percent. These increases mirror the national general aviation resurgence driven by new aircraft production and the continued increase in business and corporate use of general aviation aircraft. While the future is still uncertain for general aviation, a renewed optimism exists within the industry.

As detailed previously in Chapter Three, should activity increase as forecast, a requirement will exist for

additional runway length, width, and pavement strength, additional T-hangar and conventional hangar area, and increased airfield capacity. The remainder of this chapter will examine development alternatives considering these future requirements and the potential for commercial/industrial development on airport property.

AIRFIELD ALTERNATIVES

Airfield facilities are, by their very nature, the focal point of the airport complex. Because of their primary role and the fact that they physically dominate airport land use, airfield facility needs are often the most critical factor in the determination of viable airport development alternatives. In particular, the runway system requires the greatest commitment of land area and often imparts the greatest influence on the identification and development of other airport facilities. Furthermore, due to the nature of aircraft operations, there are a number of FAA design criteria that must be considered when looking at airfield improvements. These criteria, depending upon the areas around the airport, can often have a significant impact on the viability of various alternatives designed to meet airfield needs. There are two primary planning issues related to the airfield: 1) runway length, 2) airfield capacity

RUNWAY LENGTH

As indicated in the facility needs evaluation, at its present length, Runway 1-19 can accommodate the full-range of piston-engine and

turboprop general aviation aircraft, but falls short of fully accommodating common business jet aircraft, especially during the warmest summer months. During the warmest summer months business jet aircraft departing Glendale Municipal Airport must reduce payload and/or fuel loading.

Runway length requirements were analyzed from two perspectives, first, utilizing FAA design software which is based upon a composite mix of aircraft and second, specific runway length requirements for common business jet aircraft. FAA design software specifies a runway length requirement of 7,000 feet for Glendale Municipal Airport. Common business jet aircraft runway length requirements vary from 4,800 feet to 7,300 feet. For the alternatives analysis, the feasibility of extending Runway 1-19 to 7,300 feet has been examined, as this accommodates the most demanding business jet aircraft.

FAA runway safety area and object free area standards must be considered in examining runway length at the airport. The runway safety area (RSA) is defined as "a defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway." The object free area (OFA) is defined as "a two dimensional ground area surrounding runways, taxiways, and taxilanes which is clear of objects except for objects whose location is fixed by function." The runway safety area is 500 feet wide centered on the runway centerline and extends 1,000 feet beyond each runway end. The object free area is 800 feet wide centered on the runway centerline

and extends 1,000 feet beyond each runway end.

The existing New River gabion (a retaining wall constructed along the river channel to support earthwork and reduce erosion) is located approximately 600 feet from the Runway 1 end. At this distance from the runway end, RSA criterion is not fully met. The City engineering department has determined that a new gabion can be constructed 250 feet from the runway centerline and be extended 1,300 feet from the existing Runway 1 end without significantly disrupting flow in the New River channel (shown in orange on **Exhibit 4A**).

As shown in blue on **Exhibit 4A**, constructing the new gabion can allow for a 1,000-foot extension to the Runway 1 end while providing 300 feet from the runway end for a graded safety area. To provide the full RSA, the landing threshold must be displaced 700 feet. This involves the use of a concept known as "declared distances", which requires special approval by the FAA. Utilizing declared distances, the full 1,000-foot extension could be used for departures to the north, while 300-foot of the extension would be available for landing. The cost to extend Runway 1-19 1,000 feet south is estimated at \$1.26 million, not including the cost of constructing the gabion and providing the necessary fill. The gabion is estimated at \$1.0 million.

Extending the runway 1,000 feet places the runway protection zone (RPZ) outside the existing airport property line. The acquisition of an aviation easement or the purchase of

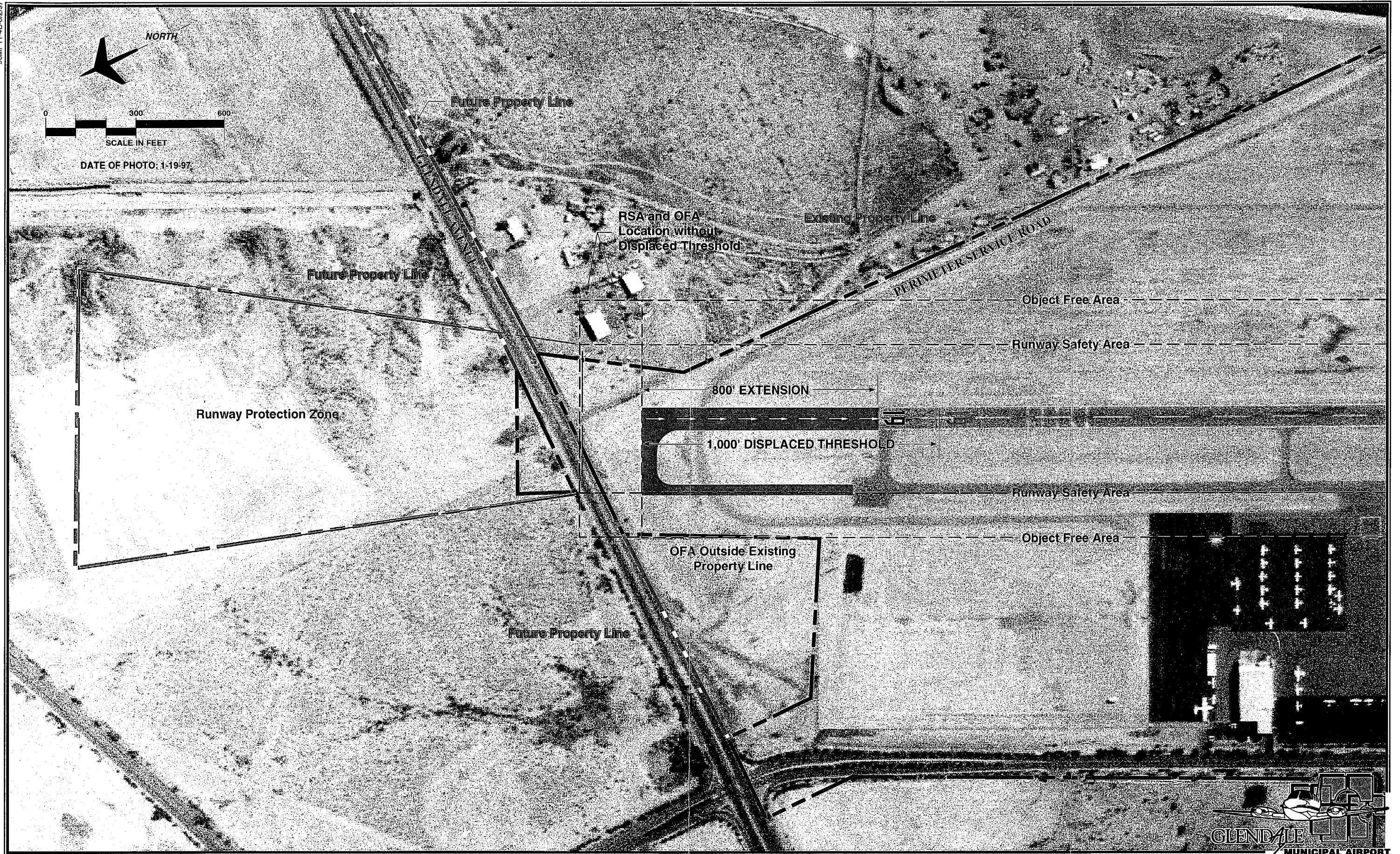
approximately 19.7 acres of land would be required to protect the RPZ.

Glendale Avenue intersects both the RSA and OFA at the Runway 19 end. To provide the full OFA and RSA and area for a perimeter service road, the Runway 19 threshold must be displaced 200 feet. Similar to the Runway 1 end, this involves the use of the declared distances concept. As shown in blue on **Exhibit 4B**, an option would be available to extend the Runway 19 end to the limits of the RSA and OFA (800 feet). This would provide an additional 800 feet of pavement for takeoff to the south, however, this pavement would not be available for landing. The cost to extend Runway 1-19 800 feet north is estimated at \$932,100.

Similar to the Runway 1 extension, extending Runway 19 800-feet north would place the RPZ outside existing airport property. The acquisition of an aviation easement or the purchase of approximately 36 acres of land would be required to protect the RPZ.

As evident on **Exhibit 4B**, a portion of the OFA extends outside the existing airport property line. The acquisition of a 6.7 acre parcel of land adjacent to the airport would protect the OFA and allow for the development of a perimeter service road. As will be shown in the landside alternatives, this property could also support future aviation growth and/or industrial/commercial development.

Exhibit 4C summarizes declared distances for Glendale Municipal Airport considering the runway extensions discussed above and the



landing threshold displacements necessary to meet RSA and OFA criterion. Specifically, declared distances incorporate the following concepts:

Takeoff Runway Available (TORA)

- The runway length declared available and suitable for the ground run of an airplane taking off;

Takeoff Distance Available (TODA)

- The TORA plus the length of any remaining runway and/or clearway beyond the far end of the TORA;

Accelerate-Stop Distance Available (ASDA)

- The runway plus stopway length declared available for the acceleration and deceleration of an aircraft aborting a takeoff; and

Landing Distance Available (LDA)

- The runway length declared available and suitable for landing.

As shown on **Exhibit 4C**, the TORA and TODA are equal to the actual pavement available. The ASDA and LDA are reduced by the amount of the displacement necessary to meet RSA and OFA criterion. The Runway 19 ASDA is reduced by 700 feet, the length necessary to provide the full RSA off the Runway 1 end. The Runway 1 ASDA is reduced 1,000 feet, the length necessary to provide the full RSA and OFA off the Runway 19 end. The LDA must provide the full RSA at the approach end of the runway, as well as at the roll-out end of the runway. This reduces the LDA 1,700 feet, the length necessary to provide the full RSA and OFA at each runway end.

Conclusion

Utilizing the declared distances concept as provided by the FAA and constructing a new gabion along the New River provides an additional 1,800 feet of pavement for takeoff at the airport. While there is only a 100-foot net gain in landing distance available, FAA requirements for full RSA and OFA areas at each runway end are met.

AIRFIELD CAPACITY

As indicated previously in the airfield capacity analysis in Chapter Three, the airport can expect to reach 82.4 percent of its annual service volume by the end of the long term planning horizon. Should activity occur as forecast, the airport can be expected to exceed the FAA recommended planning threshold of 60 percent of annual service volume by the intermediate planning horizon activity milestone (175,000 annual operations). Therefore, it is necessary to consider alternatives for increasing airfield capacity at Glendale Municipal Airport to accommodate forecast demand as this may occur within the planning period of this master plan.

In reviewing alternatives for increasing airfield capacity at Glendale Municipal Airport, it is possible to consider several alternatives, including the "no action" alternative. Basically, this involves maintaining the airfield in its present configuration. As previously discussed, as the number of annual aircraft operations approaches the airfield's capacity, increasing amounts of delay to aircraft operations occur.

Additionally, as the mix of aircraft changes to include larger, faster aircraft, increasing amounts of delay occur as larger separation distances must be maintained between different types of aircraft. **Table 4A** summarizes airfield delay should no capacity improvements be completed at the airport. At current airfield

capacity and operational levels, the average delay per aircraft operation is estimated at 9 seconds and totals 296 hours annually. Should no capacity improvements be completed, the average annual delay per aircraft is estimated to increase to 27 seconds per aircraft and total 1,613 hours annually.

TABLE 4A
Comparison of Capacity Improvement Alternatives

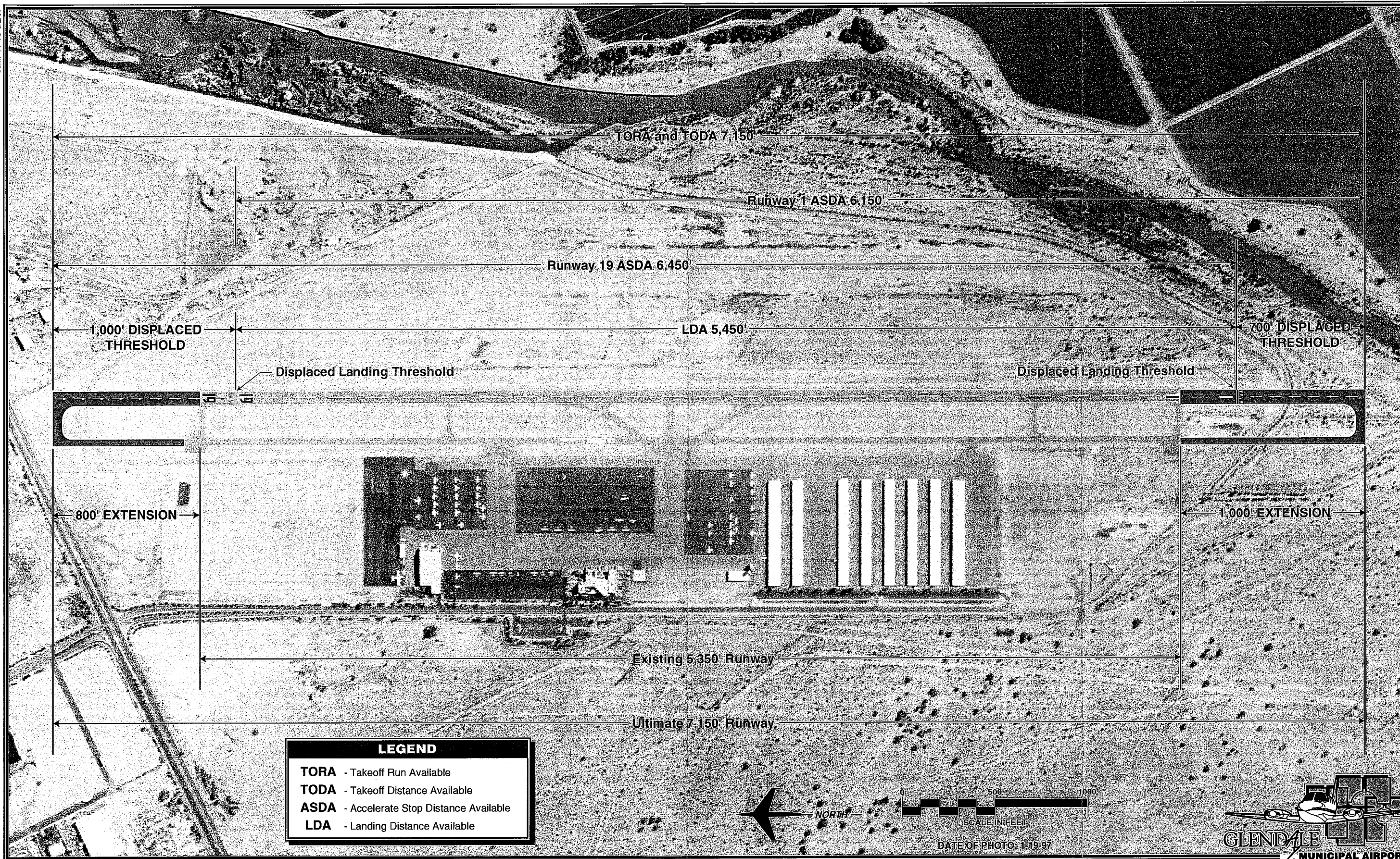
	1996	Short Term	Intermediate Term	Long Term
Annual Operations	118,387	139,000	175,000	215,000
Existing Airfield (No Action)				
Annual Service Volume	271,000	269,000	267,000	261,000
Operations % of ASV	43.7%	51.7%	65.5%	82.4%
Annual Aircraft Delay (Hours)	296	463	730	1,613
Average Delay Per Aircraft (Minutes)	.15	.20	.25	.45
Exit Taxiway Improvements				
Annual Service Volume	288,000	286,000	282,000	275,000
Operations % of ASV	41.4%	48.6%	62.1%	78.2%
Annual Aircraft Delay (Hours)	236	416	613	1,075
Average Delay Per Aircraft (Minutes)	.12	.18	.21	.30
Construct Parallel Runway				
Annual Service Volume	413,000	409,000	407,000	403,000
Operations % of ASV	28.7%	34.0%	43.0%	53.3%
Annual Aircraft Delay (Hours)	11,800	13,900	26,300	43,000
Average Delay Per Aircraft (Minutes)	.09	.10	.15	.20

Taxiway Improvements

Taxiway improvements are one means of improving the operational efficiency and capacity of the airfield. Adequate runway exits and circulation are essential to achieving the optimum capacity potential of any runway system. Since taxiway improvements are generally far less expensive than runway improvements, it is important to ensure maximum capabilities are

being derived from the taxiway system before making runway changes to improve capacity.

The ideal taxiway system would include a full-length parallel taxiway for each runway with adequate exits spaced along the runway to reduce runway occupancy time. In some cases, high speed exits can further minimize occupancy time. Connecting taxiways would be available, as



necessary, to provide convenient access between the airfield and various terminal facilities on the airport.

Presently, Runway 1-19 is served by a full-length parallel runway. An exit taxiway is available at each runway end. Additional exit taxiways include a midfield exit taxiway, two acute-angled (high speed) exit taxiways located approximately 400 feet either side of the midfield exit taxiway, an exit taxiway 1,350 feet from the Runway 19 threshold, and an exit taxiway 800 feet from the Runway 1 threshold.

To examine the potential improvements to the annual service volume, the capacity analysis was run assuming that the exit rating was maximized. The maximum exit taxiway rating requires at least four taxiways, 750 feet apart, between 2,000 and 4,000 feet from the threshold. Presently, under the capacity model, Runway 1 is credited with three exits and Runway 19 is credited with two exits. **Table 4A** compares the results to the annual service volume of the existing airfield system. Adding taxiway exits would increase the annual service volume under current operational conditions approximately 6 percent, from 271,000 to 288,000. This would reduce existing (1996) annual operations to approximately 41 percent of the annual service volume. However, as can be seen from **Table 4A**, even with exit taxiway improvements, the airfield capacity would still exceed 60 percent of annual service volume at intermediate planning horizon activity levels. As mentioned previously, the FAA recommends planning for additional airfield capacity when annual operations reach this threshold.

Construct Parallel Runway

When possible, the best means for improving airfield capacity is the development of a parallel runway. As shown in **Table 4A**, developing a parallel runway could increase airfield capacity by as much as 52 percent and reduce long term annual delay by 55 percent. **Exhibit 4D**, depicts the development of a parallel runway. As shown, this runway would be centered at the existing midfield runway exit taxiway and be located 700 feet from the existing runway centerline, the minimum separation distance permitted by the FAA for simultaneous visual operations. Centering the parallel runway along the existing midfield taxiway ensures that RSA criterion is fully met. At the minimum separation distance, and providing for the OFA and RSA, the parallel runway would effectively prevent any other type of development east of Runway 1-19. The cost of constructing a parallel runway as shown, including pavement edge lighting, and visual glideslope indicators is estimated at \$4.64 million.

Conclusions

A small gain in airfield capacity can be achieved with the development of additional exit taxiways. However, the increased airfield capacity may not be sufficient to accommodate projected long term demand. The best means available to accommodate forecast demand efficiently at Glendale Municipal may be through the development of a parallel runway. However, the development of a parallel runway at Glendale Municipal Airport effectively prevents any future development east of Runway 1-19 on

existing airport property. As will be shown in the landside alternatives, another option is available to develop the east side of the airport for aviation and industrial/commercial development. This could provide additional revenue possibilities for the airport and economic development opportunities for the City of Glendale.

LANDSIDE ALTERNATIVES

The primary landside facilities to be accommodated at the airport include fixed based operator facilities, aircraft storage hangars, the aircraft parking apron, public terminal building, and fuel storage facilities. Other landside development should be considered which could provide revenue enhancement possibilities for the airport and economic development opportunities for the City of Glendale.

Exhibits 4E and 4F depict landside alternatives for Glendale Municipal Airport. **Exhibit 4E** considers development options should the City of Glendale construct a parallel runway. **Exhibit 4F** considers options for developing the east side of the airport for revenue generating purposes.

Shown in blue on both exhibits are areas currently available for development. The hangar area north of Glendale Aviation can accommodate between 175 and 200 hangar units (depending on the size of hangars). An area for the development of fifteen 3,600 square-foot hangar units is available at the south end of the existing shade and T-hangar area. An area for the development of commercial general aviation facilities is available

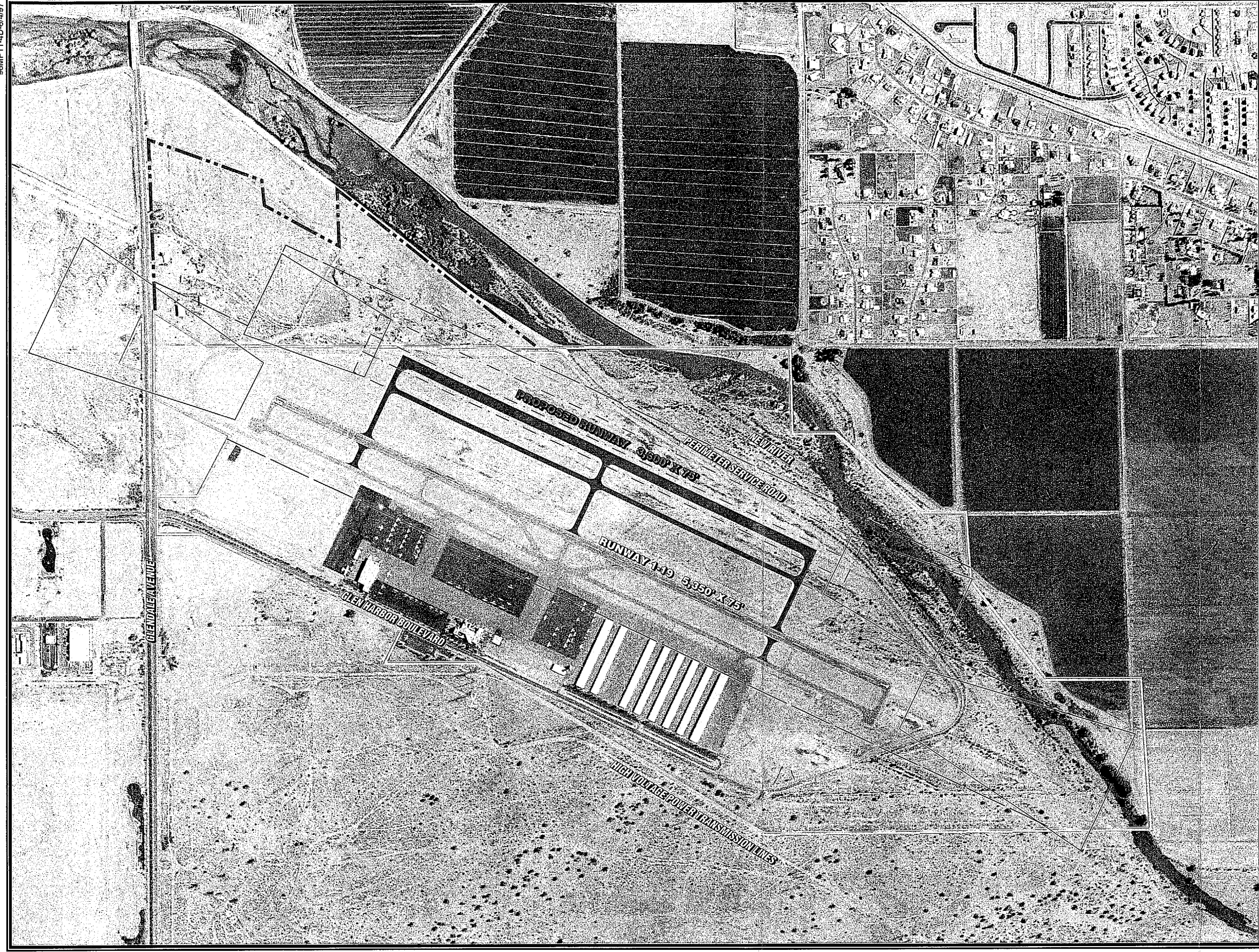
at the south end of the terminal building. A taxiway extends from the apron to provide access to two 4,200 square-foot hangars and one 8,100 square-foot hangar. Additionally, Action Aviation has a lease with the City of Glendale for the development of single and multiple aircraft storage hangars on a 30,000 square-foot parcel of apron north of the terminal building.

Shown in green on both exhibits are areas for potential hangar development. The existing site plan for Glendale Airport Hangars depicts the ultimate development of two additional shade and/or T-hangar facilities. A large FBO hangar, similar in size to the existing city-owned FBO hangar, could be developed in the vacant area south of the terminal building.

These potential development areas combined with the currently planned hangar developments exceed projected long term aircraft storage hangar requirements. Therefore, the alternatives analysis has not examined additional hangar development areas. Instead, the landside alternatives have concentrated on identifying areas for industrial/commercial development.

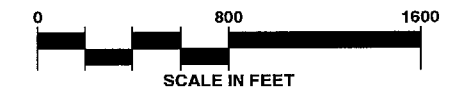
Exhibit 4E depicts two areas for industrial/commercial development should a parallel runway be constructed east of Runway 1-19. As shown on the exhibit, 38.5 acres of land (of a total 55 acres of land that the airport is currently purchasing northeast of Runway 1-19) would be available for development once the parallel runway is constructed. Much of the property would have excellent development potential as its fronts Glendale Avenue. Airfield access could

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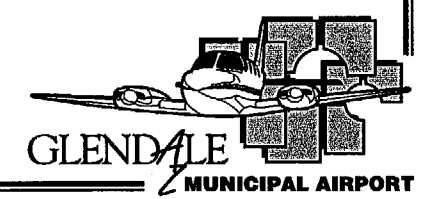


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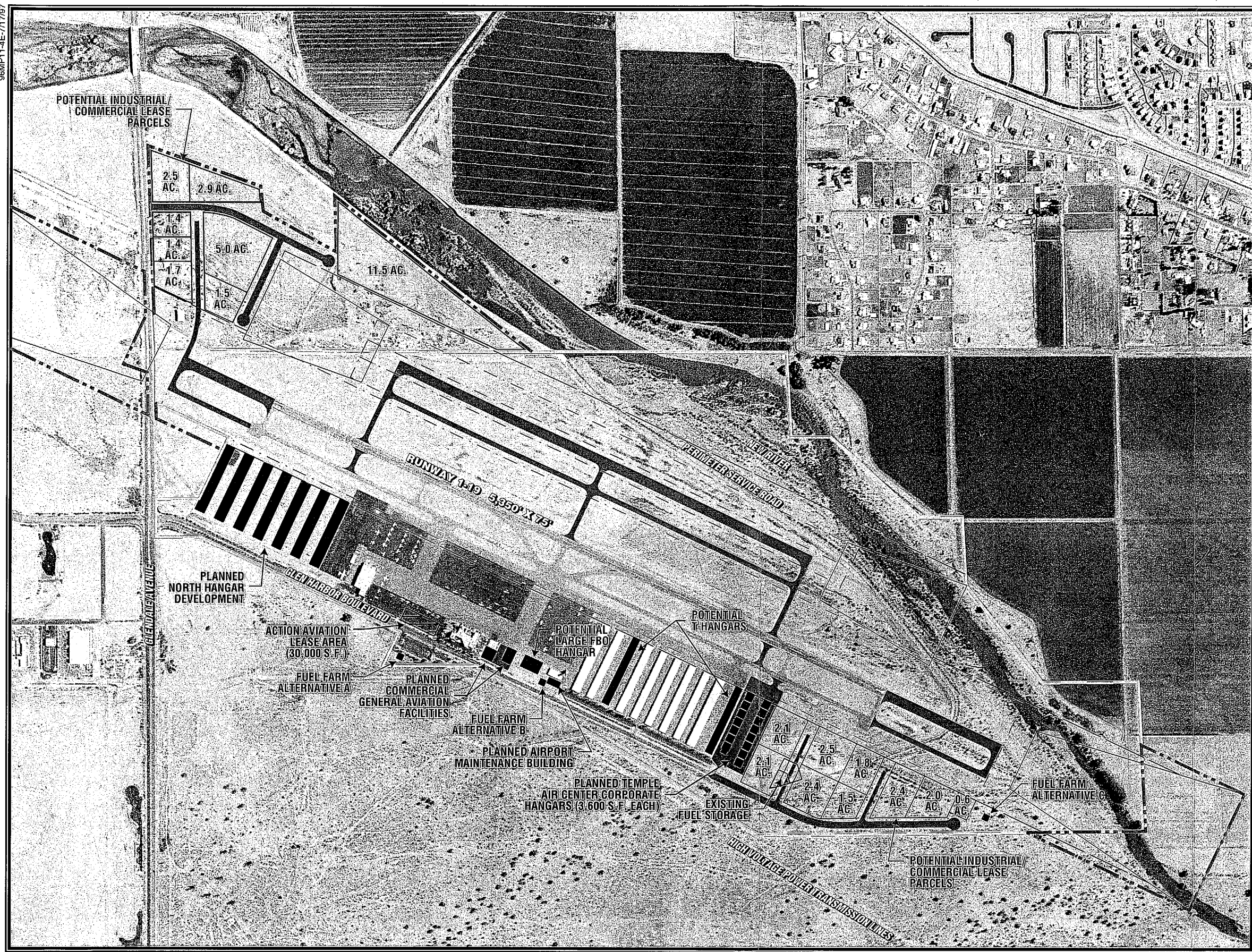
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- Future Airport Property Line
- Runway Protection Zone
- Runway Safety Area
- Building Restriction Line
- Object Free Area



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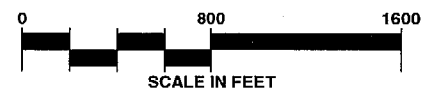


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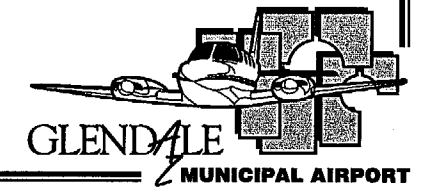


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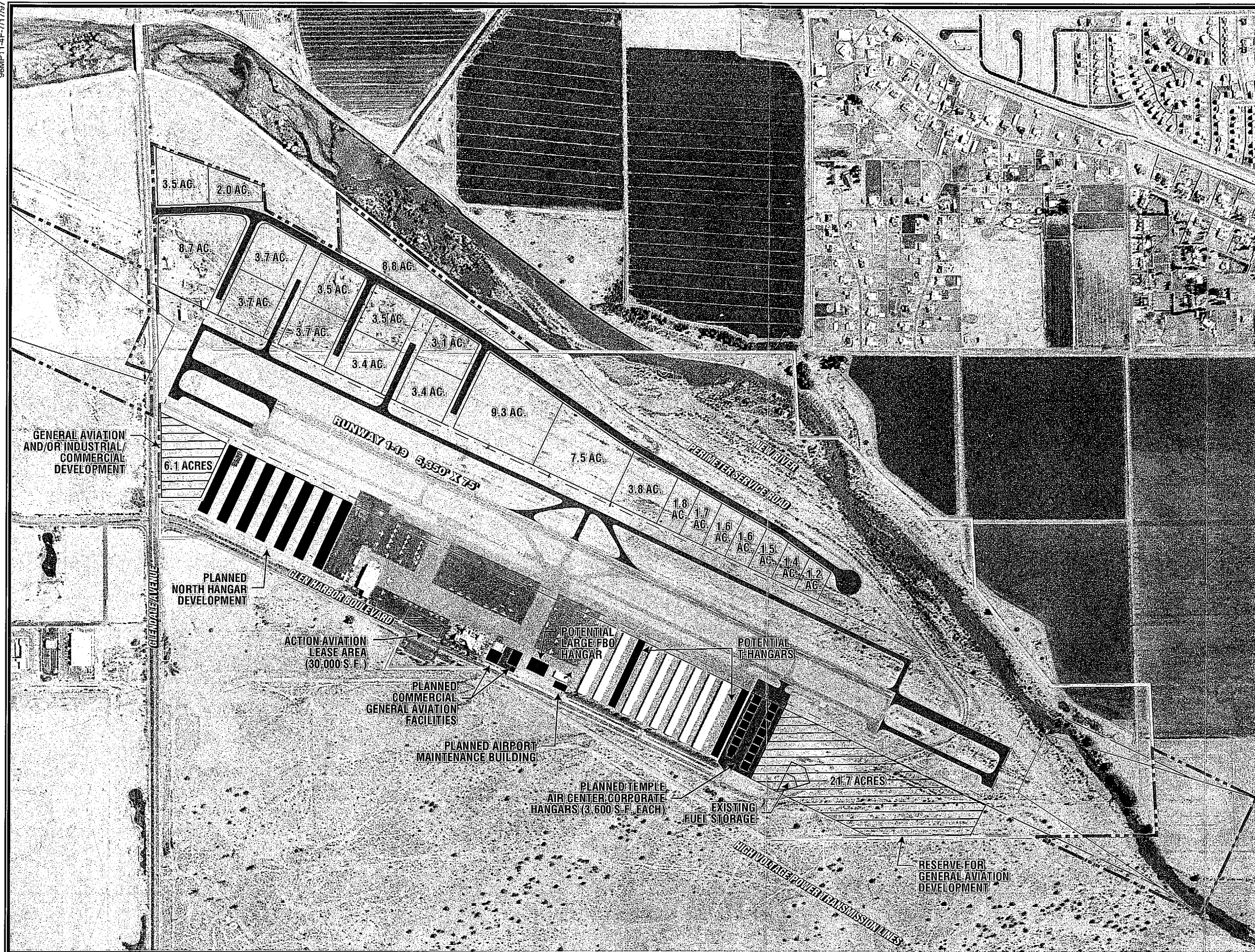
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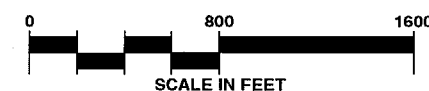


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- Existing Airport Property Line
- Future Airport Property Line
- Runway Protection Zone
- Building Restriction Line
- Object Free Area



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be developed via a taxiway connecting to the parallel runway threshold. A second area for industrial/commercial development is shown for the vacant area south of the planned Temple Air hangar development area. As shown, there is approximately 17 acres of land available for development. Six of the nine development parcels could ultimately have airfield access should Runway 1-19 be extended to the south. The cost to develop roads and extend utilities for both areas is estimated at \$402,700. The taxiway providing access to the northeast industrial commercial parcels is estimated at \$481,000. At an annual lease rate of 12 cents per square-foot, the 56 acres shown for development under this alternative, could produce approximately \$292,600 in annual revenue for the airport.

Exhibit 4F depicts development options should the existing single runway configuration be maintained. As shown, the west side of the airport could be dedicated to general aviation development, whereas, the east side could be dedicated to industrial/commercial development. As shown, a total of 82 acres of land would be available for industrial/commercial development east of Runway 1-19. A parallel taxiway could be developed to provide airfield access to all parcels. As shown, a variety of lease parcel sizes could be accommodated at the site and could be flexible to individual needs. The cost to develop the parallel taxiway and taxiway stubs as shown in this alternative is estimated at \$2.9 million. The cost to develop roads and extend utilities is estimated at \$578,600. At an annual lease rate of 12 cents per square-foot, the 82 acres shown for development under this

alternative, could produce approximately \$430,600 in annual revenue for the airport.

The existing fuel storage tanks are located in a fenced area south of the existing shade and T-hangar area. Future development south of the existing shade and T-hangar area may require that the existing fuel storage tanks be relocated to a different area. **Exhibit 4E** depicts three alternative locations for fuel storage. Alternative A locates fuel storage on airport property west of the terminal building overflow parking lot. This location offers direct access for fuel tanker trucks but does not provide airfield access for on-airport fuel delivery trucks. Alternative B locates fuel storage near the aircraft wash racks, between the apron and Glen Harbor Boulevard. This location can be easily accessed by fuel tanker trucks and on-airport fuel delivery trucks. However, this location may limit hangar development area along the apron. Alternative C locates fuel storage at the far south end of the airport. This alternative is somewhat dependent on an extension of Glen Harbor Boulevard to provide access for fuel tanker trucks. Should Glen Harbor Boulevard be extended as shown, this location could be easily accessed by both fuel tanker trucks and on-airport fuel delivery trucks.

SUMMARY

A preliminary master plan concept will be developed after the alternatives are reviewed by the Planning Advisory Committee and the City of Glendale. Once the preliminary master plan

concept has been identified, cost estimates will be prepared for the individual projects, a development schedule will be prepared, and potential funding sources for recommended projects will be identified (including those projects that are

eligible for federal or state funding assistance). The remaining chapters of the master plan will be used to refine a final concept through the development of detailed layouts and a phased construction program.